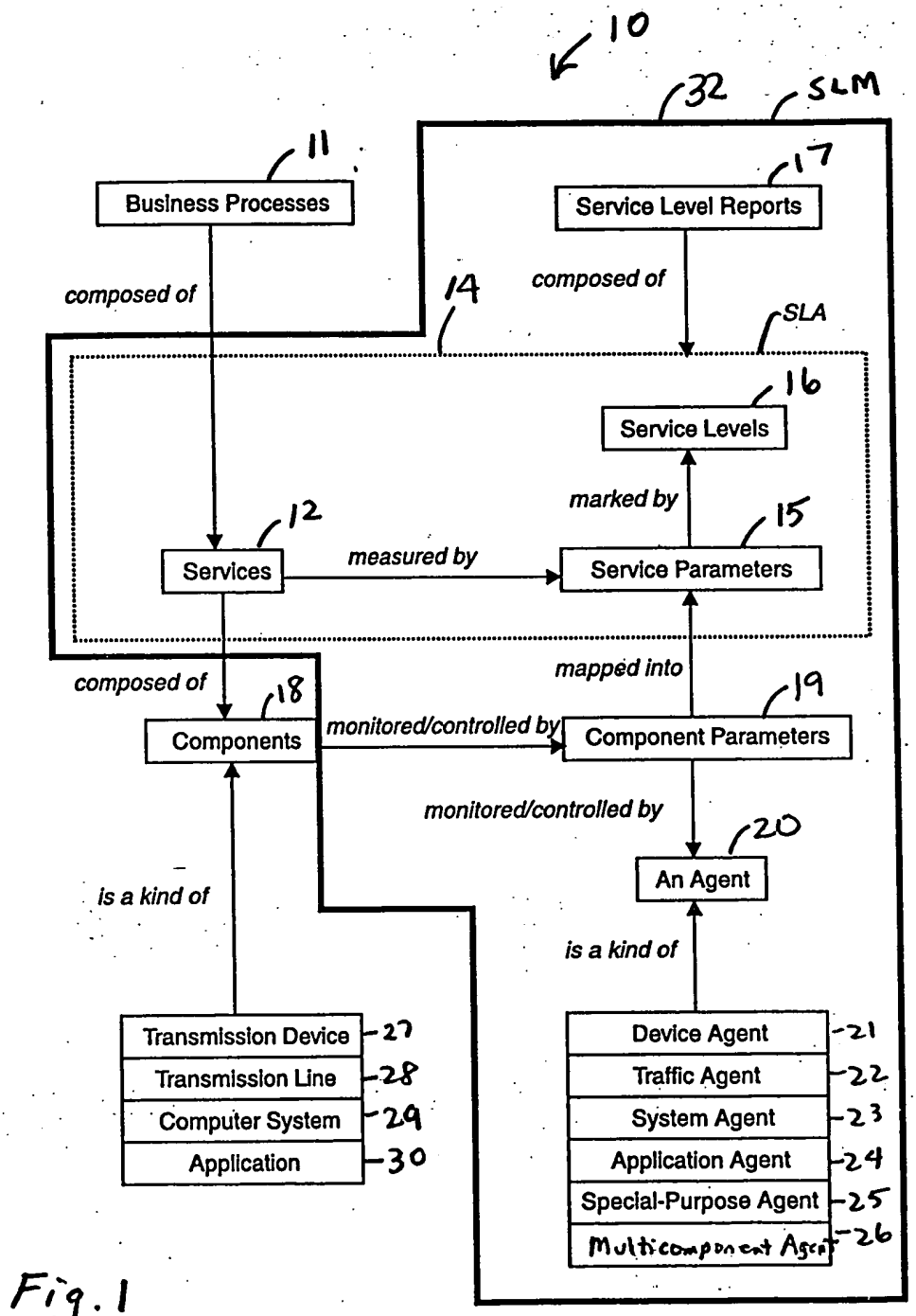

10
32
SLM
11
Business Processes
17
Service Level Reports
composed of
14
composed of
SLA
16
Service Levels
marked by
12
15
Services
measured by
Service Parameters
composed of
mapped into
18
19
Components
monitored/controlled by
Component Parameters
monitored/controlled by
20
An Agent
is a kind of
is a kind of
Transmission Device
27
Transmission Line
28
Computer System
29
Application
30
Device Agent
21
Traffic Agent
22
System Agent
23
Application Agent
24
Special-Purpose Agent
25
Multicomponent Agent
26

Fig. 1

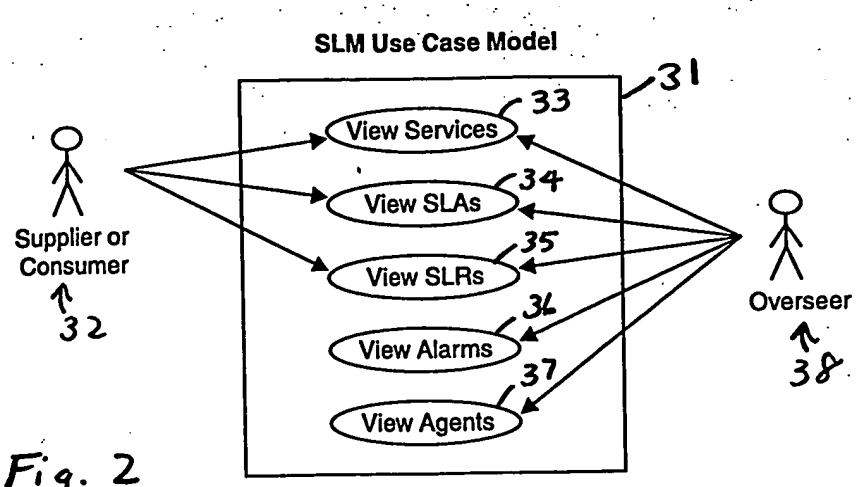


Fig. 2

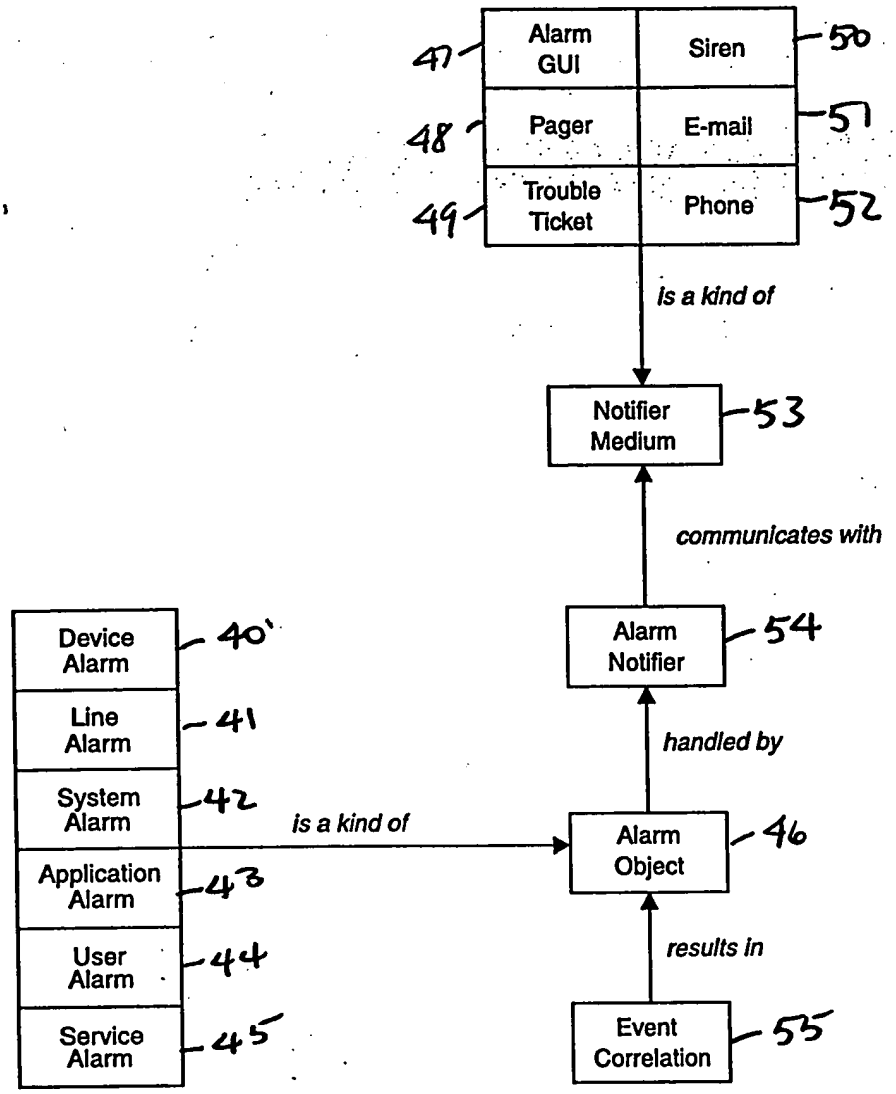

Alarm GUI
Siren
Pager
E-mail
Trouble Ticket
Phone
47
48
49
50
51
52
is a kind of
Notifier Medium
53
communicates with
Alarm Notifier
54
handled by
Alarm Object
46
results in
Event Correlation
55
Device Alarm
40'
Line Alarm
41
System Alarm
42
Application Alarm
43
User Alarm
44
Service Alarm
45
is a kind of

Fig. 3

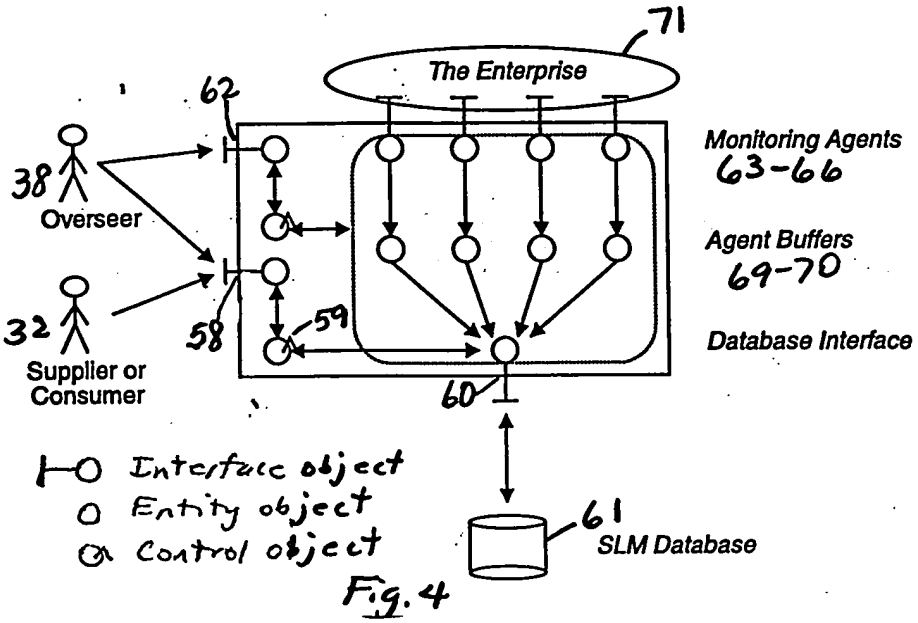

71
The Enterprise
62
38
Overseer
32
Supplier or
Consumer
58
59
60
Monitoring Agents
63-66
Agent Buffers
69-70
Database Interface
Interface object
Entity object
Control object
61
SLM Database

Fig. 4

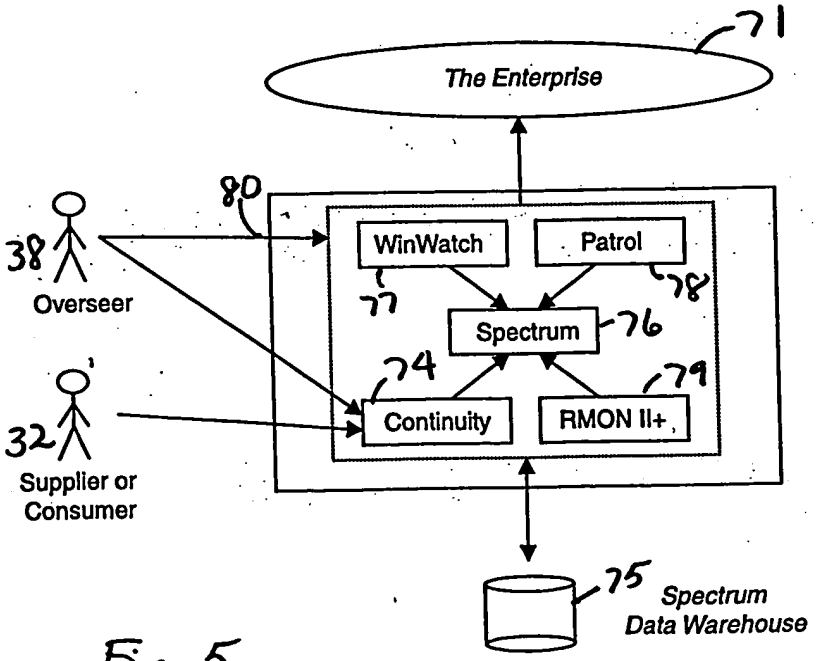

71
The Enterprise
80
38
Overseer
32
Supplier or
Consumer
WinWatch
Patrol
77
78
Spectrum
76
74
79
Continuity
RMON II+
75
Spectrum
Data Warehouse

Fig. 5

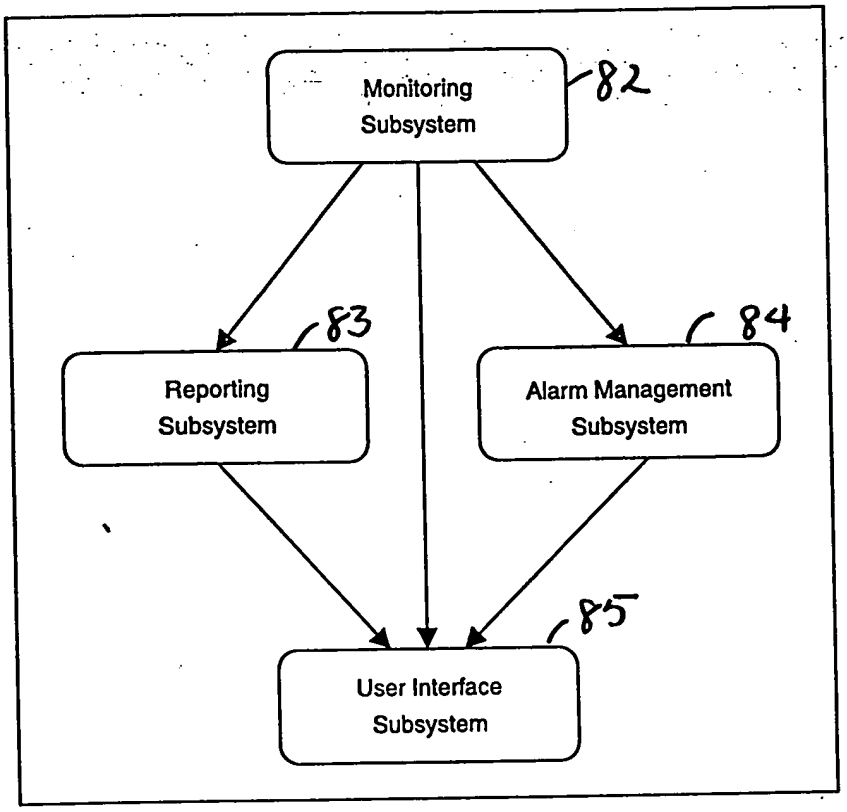

Monitoring Subsystem
82
Reporting Subsystem
83
Alarm Management Subsystem
84
User Interface Subsystem
85

Fig. 6

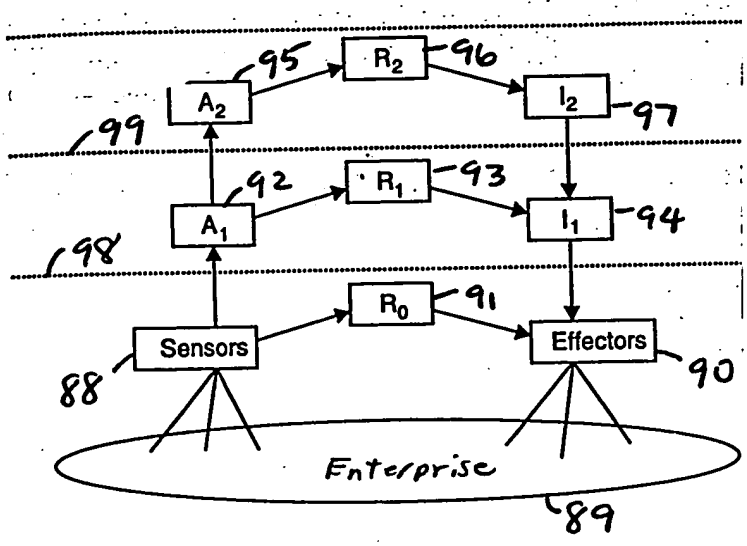

95
R_2
96
A_2
I_2
97
99
92
R_1
93
A_1
I_1
94
98
R_0
91
Sensors
Effectors
88
90
Enterprise
89

Fig. 7

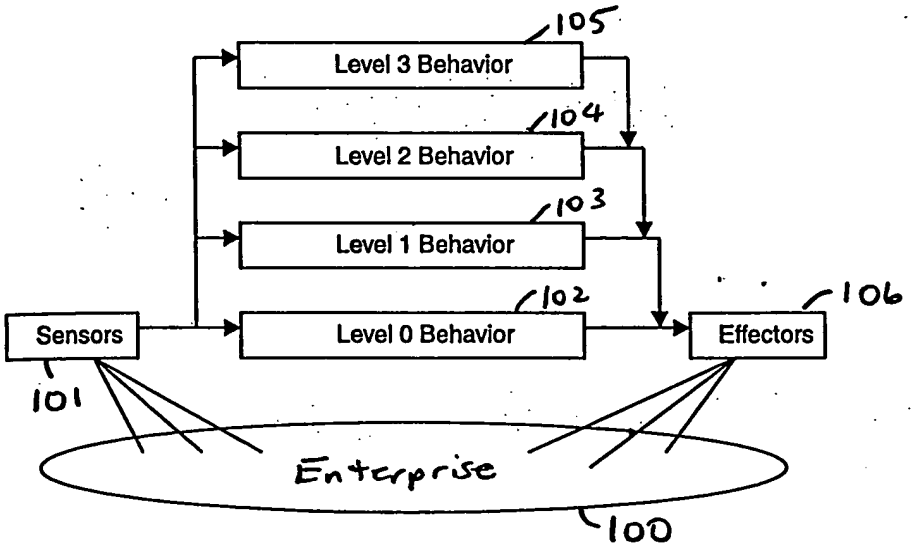

105
Level 3 Behavior
104
Level 2 Behavior
103
Level 1 Behavior
102
106
Sensors
Level 0 Behavior
Effectors
101
Enterprise
100

Fig. 8

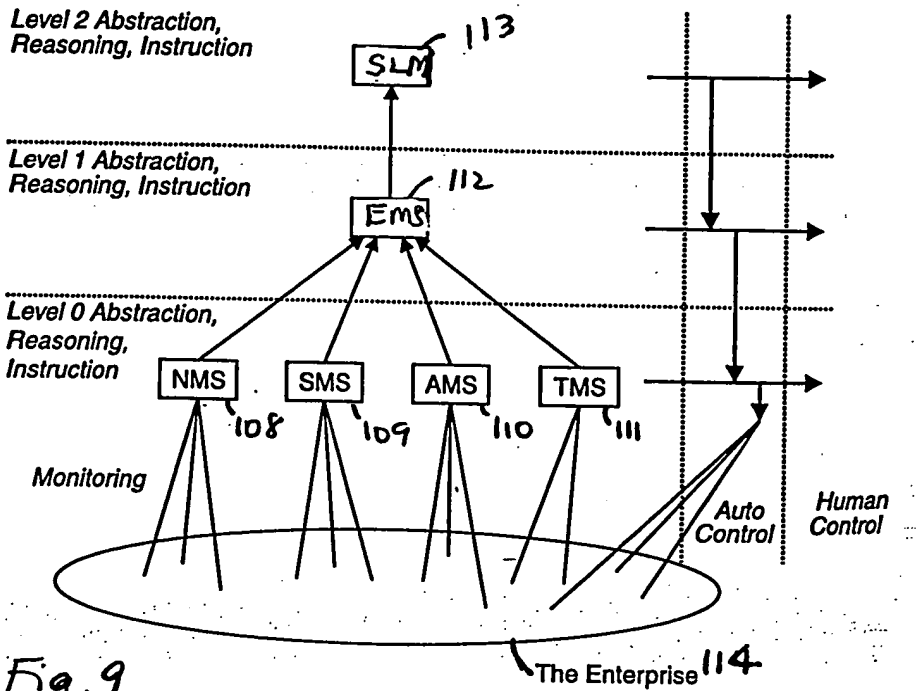

Level 2 Abstraction, Reasoning, Instruction
SLM
113
Level 1 Abstraction, Reasoning, Instruction
EMS
112
Level 0 Abstraction, Reasoning, Instruction
NMS
SMS
AMS
TMS
108
109
110
111
Monitoring
Auto Control
Human Control
The Enterprise
114

Fig. 9

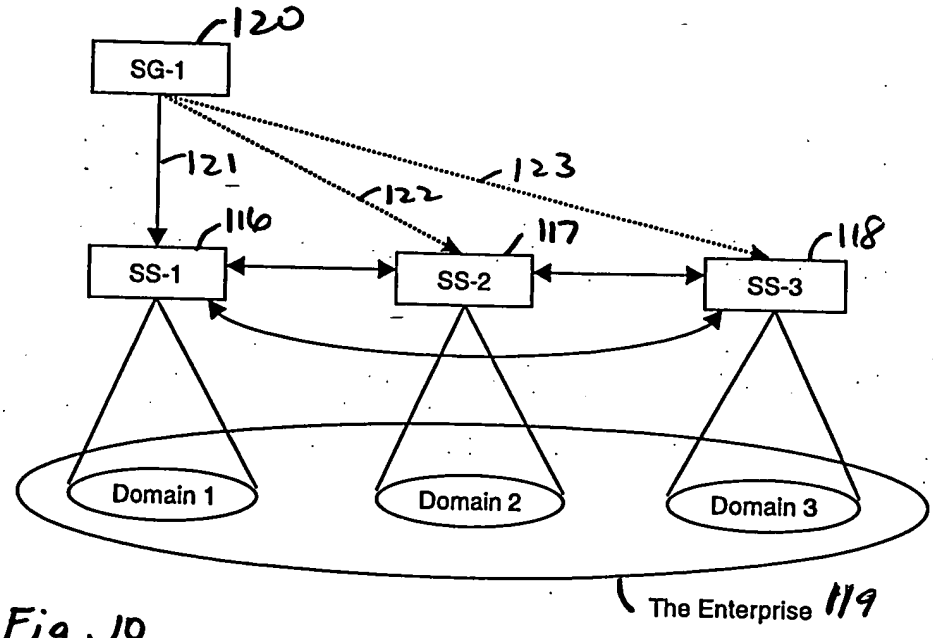

SG-1
120
121
122
123
SS-1
SS-2
SS-3
116
117
118
Domain 1
Domain 2
Domain 3
The Enterprise
119

Fig. 10

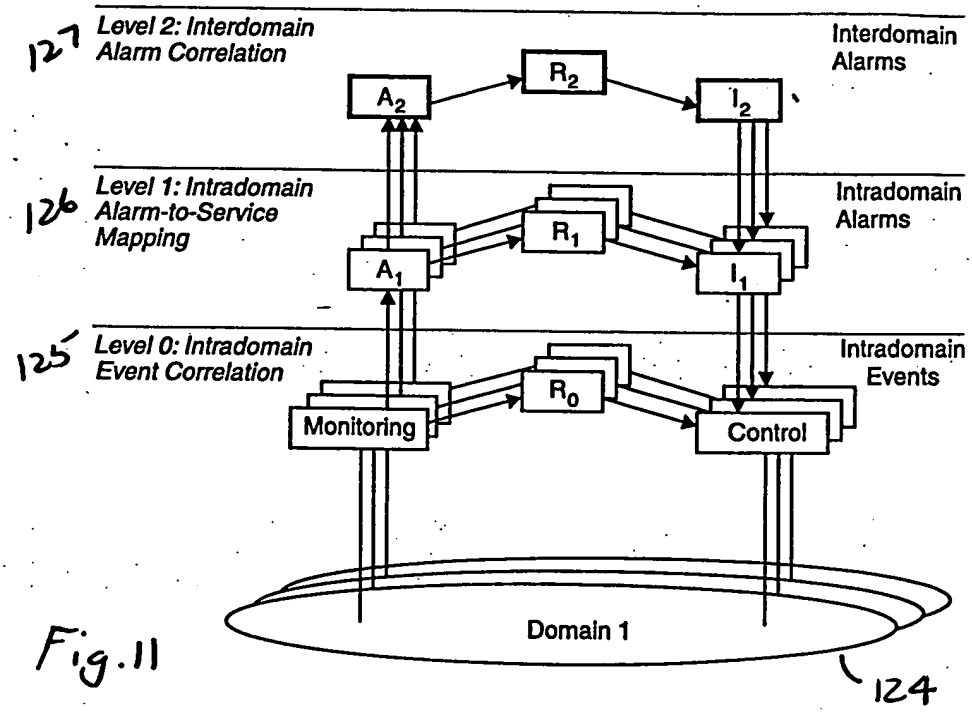

Level 2: Interdomain Alarm Correlation
127
Interdomain Alarms
A2
R2
I2
Level 1: Intradomain Alarm-to-Service Mapping
126
Intradomain Alarms
A1
R1
I1
Level 0: Intradomain Event Correlation
125
Intradomain Events
Monitoring
R0
Control
Domain 1
124

Fig. 11

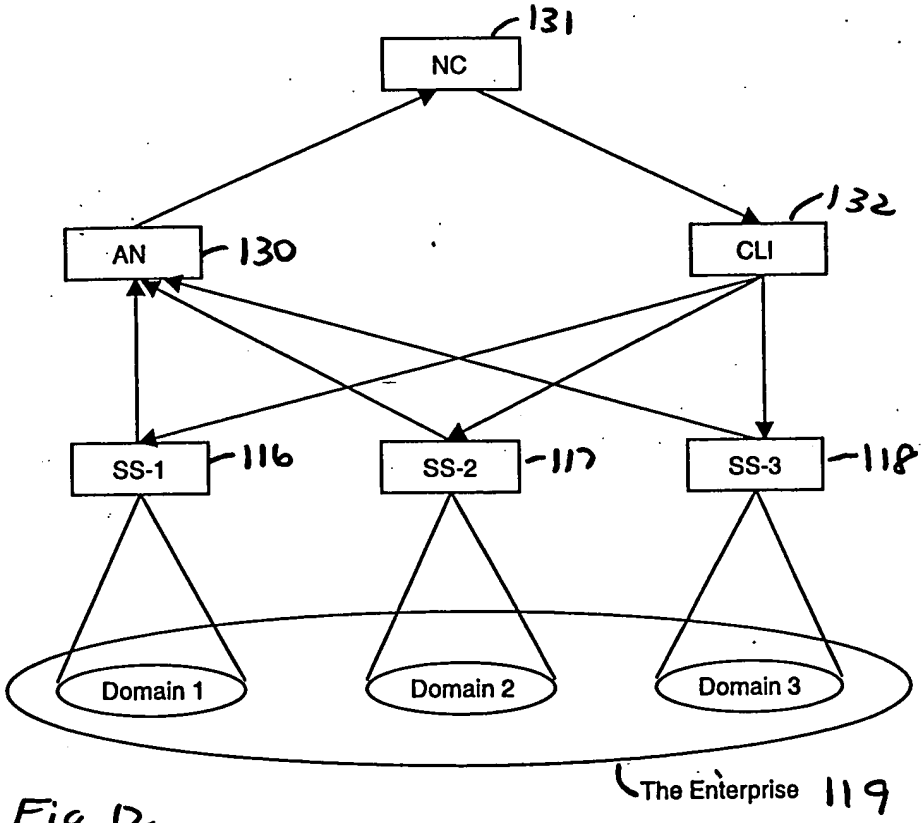

131
NC
132
AN
130
CLI
SS-1
116
SS-2
117
SS-3
118
Domain 1
Domain 2
Domain 3
The Enterprise
119

Fig. 12

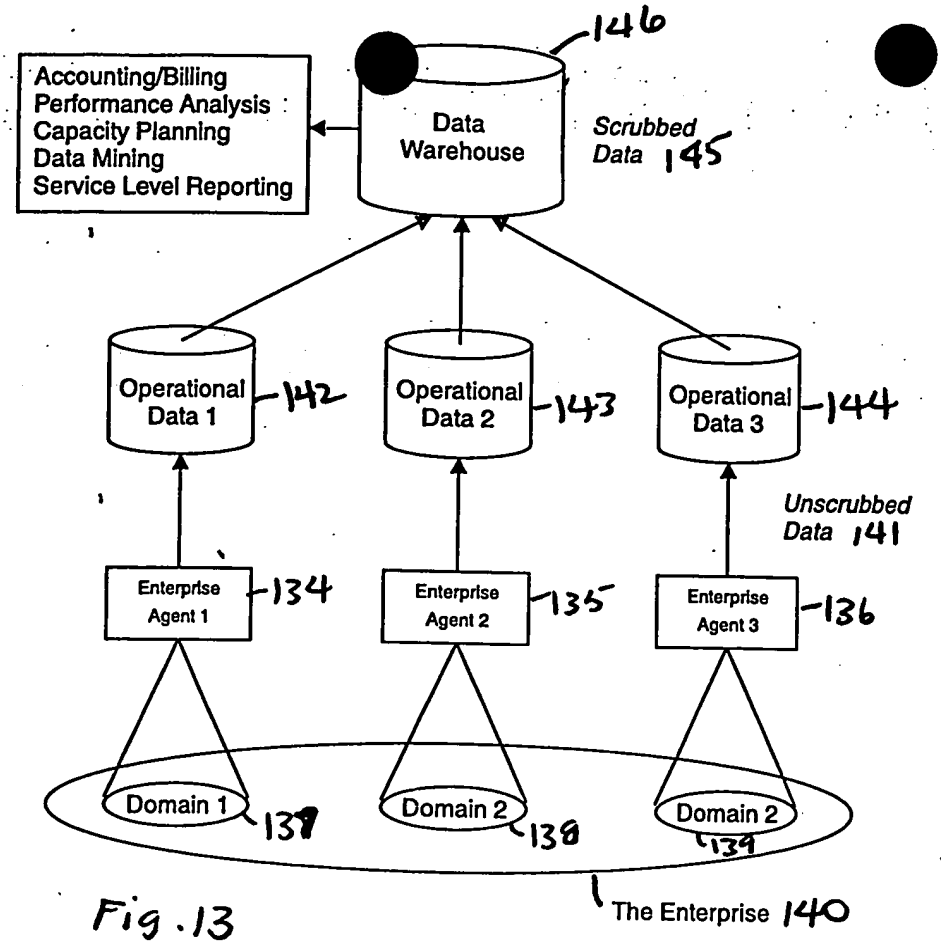

Accounting/Billing
Performance Analysis
Capacity Planning
Data Mining
Service Level Reporting
Data Warehouse
146
Scrubbed Data 145
Operational Data 1
142
Operational Data 2
143
Operational Data 3
144
Unscrubbed Data 141
Enterprise Agent 1
134
Enterprise Agent 2
135
Enterprise Agent 3
136
Domain 1
137
Domain 2
138
Domain 2
139
The Enterprise 140

Fig. 13

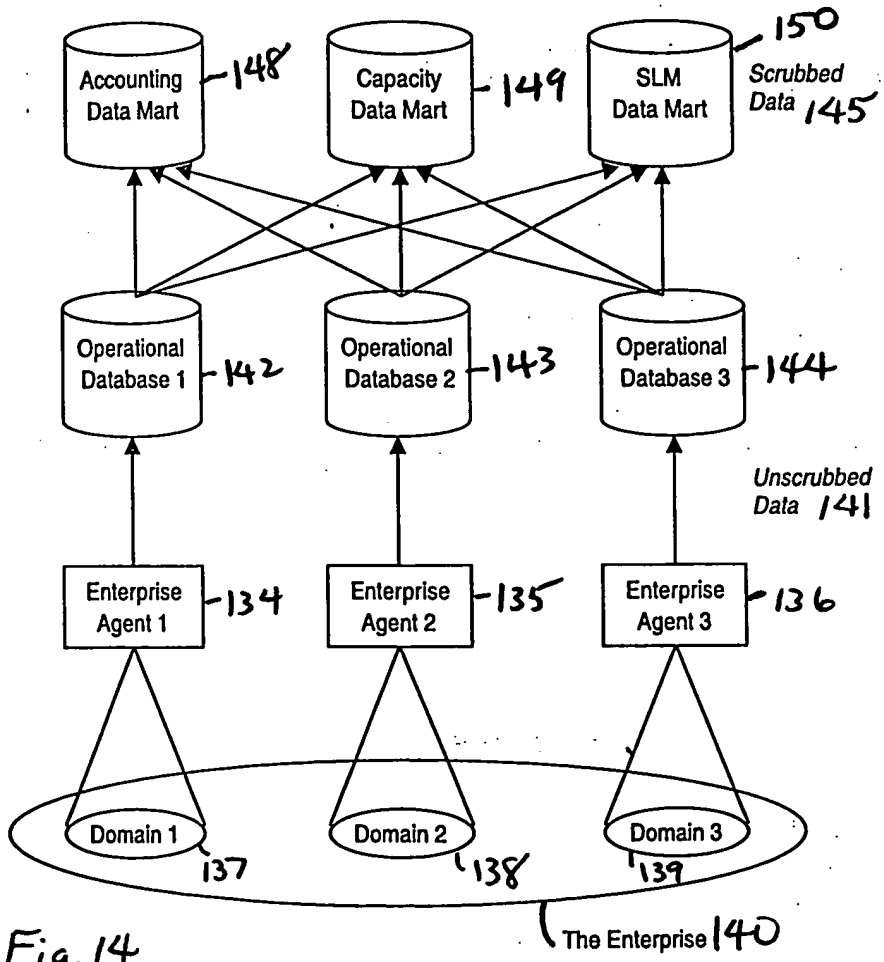

Accounting Data Mart
148
Capacity Data Mart
149
SLM Data Mart
150
Scrubbed Data 145
Operational Database 1
142
Operational Database 2
143
Operational Database 3
144
Unscrubbed Data 141
Enterprise Agent 1
134
Enterprise Agent 2
135
Enterprise Agent 3
136
Domain 1
137
Domain 2
138
Domain 3
139
The Enterprise 140

Fig. 14

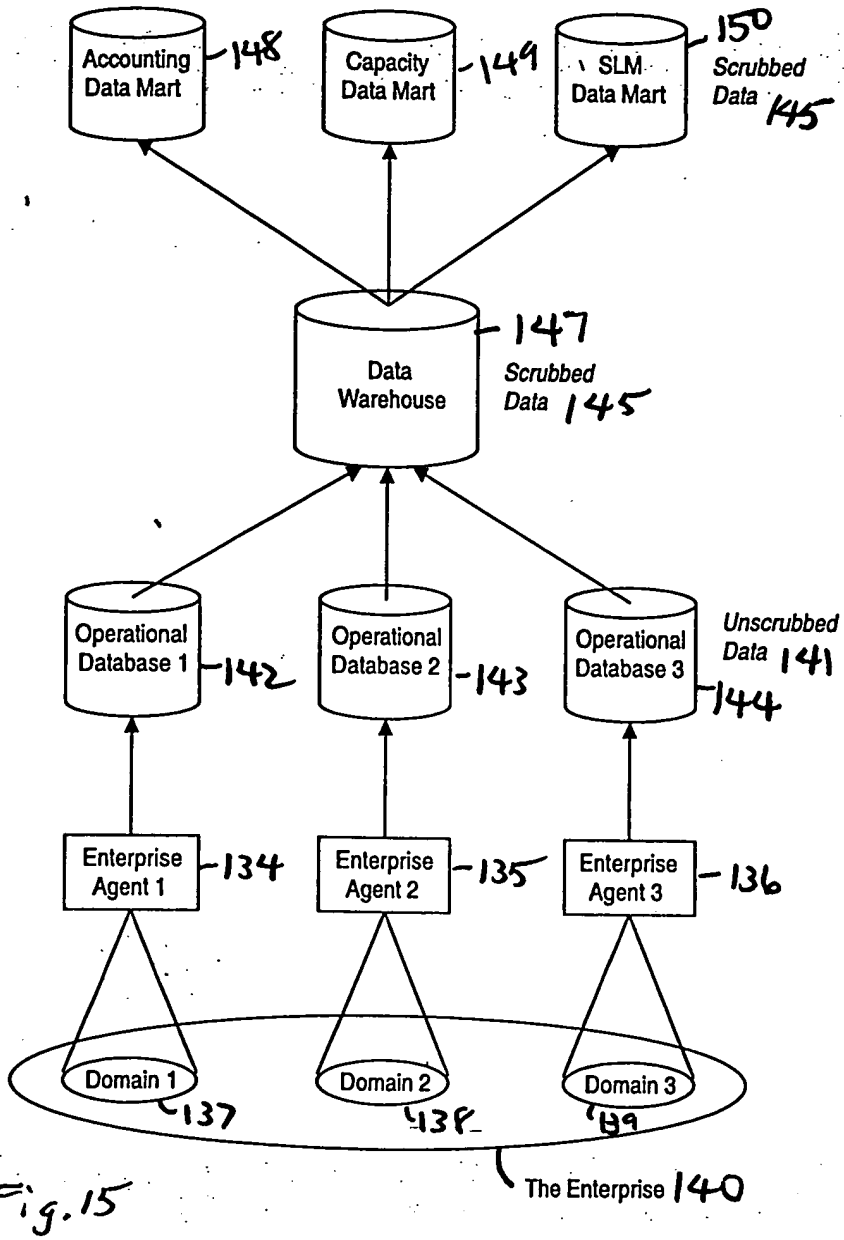

Accounting Data Mart
148
Capacity Data Mart
149
SLM Data Mart
150
Scrubbed Data 145
Data Warehouse
147
Scrubbed Data 145
Operational Database 1
142
Operational Database 2
143
Operational Database 3
144
Unscrubbed Data 141
Enterprise Agent 1
134
Enterprise Agent 2
135
Enterprise Agent 3
136
Domain 1
137
Domain 2
138
Domain 3
139
The Enterprise 140

Fig. 15

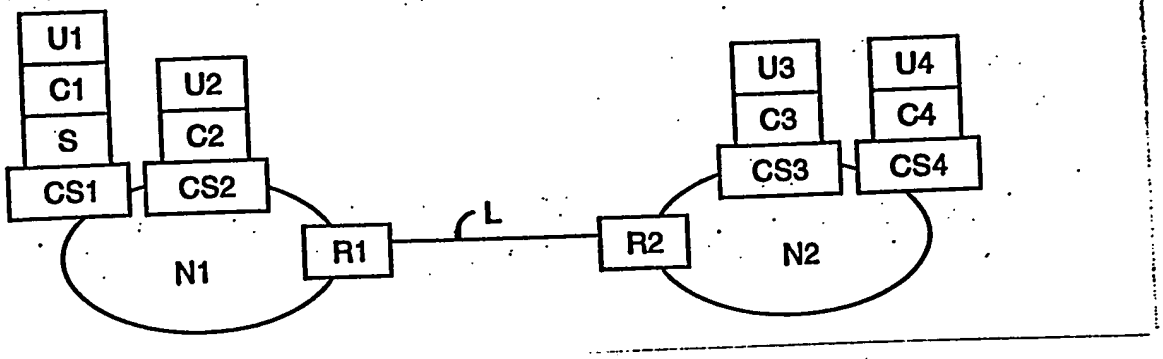


Figure 5.1 Fig. 16

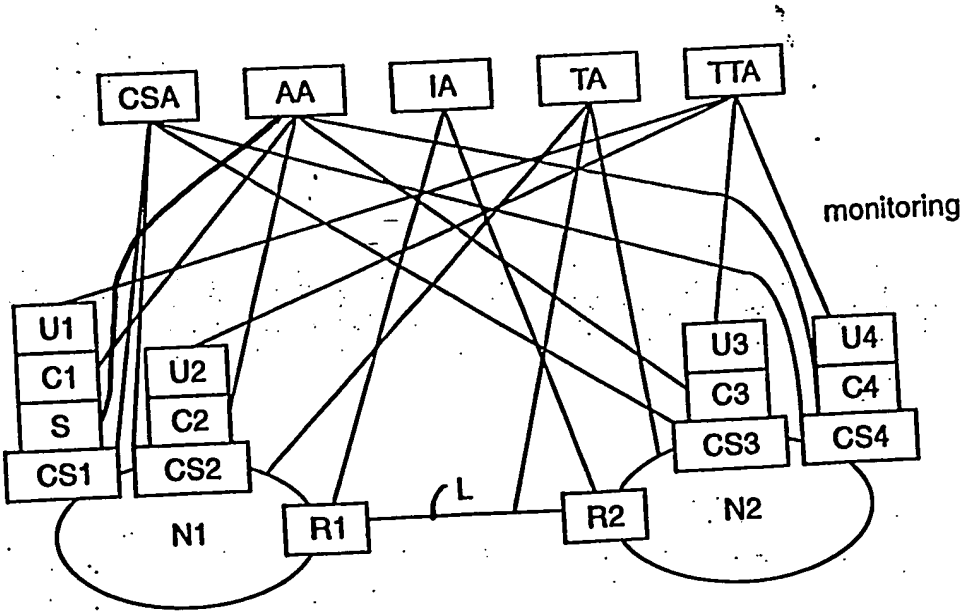


Figure 5.2 Fig. 17

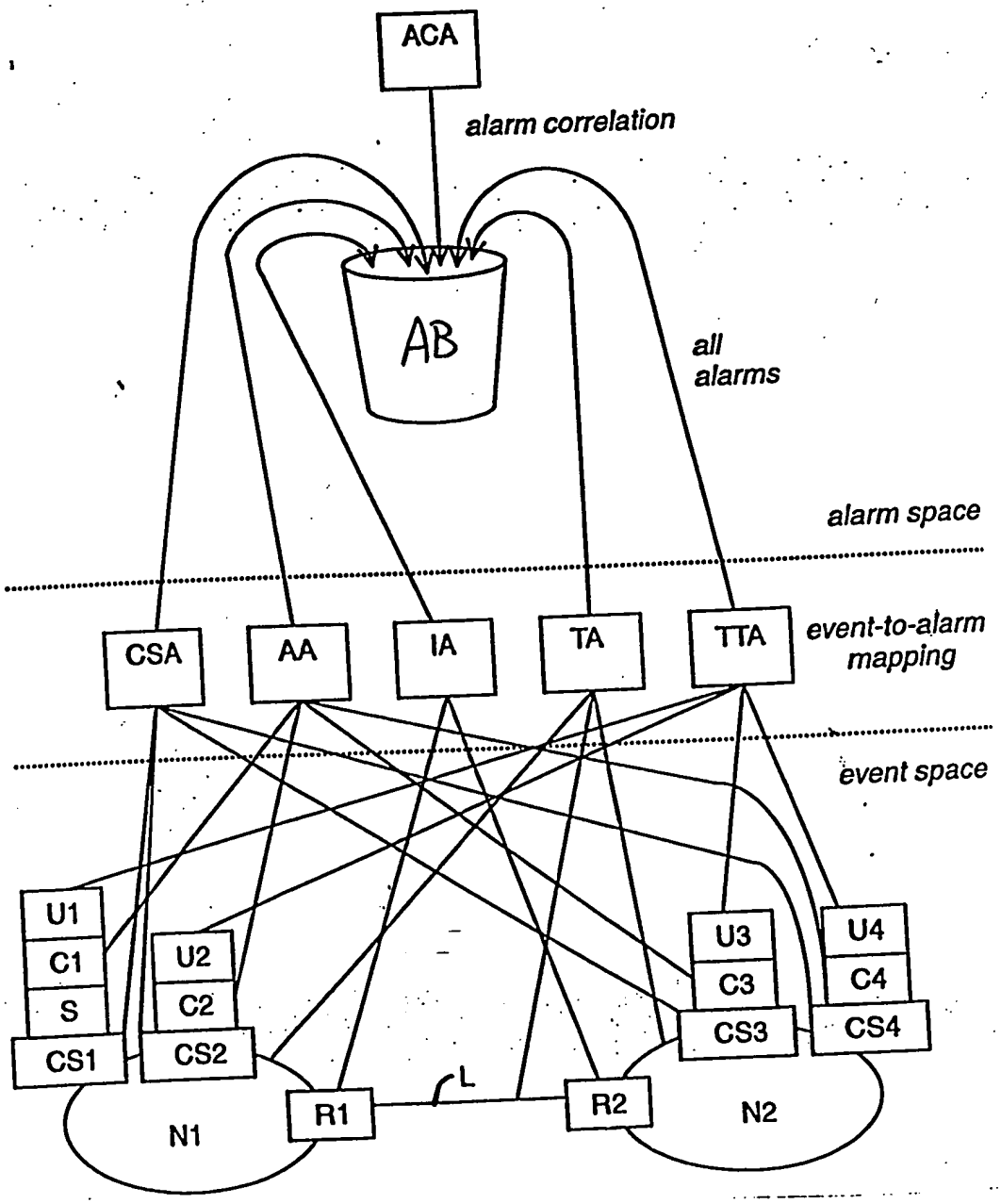


Figure 5.5

Fig. 18

Fig. 19

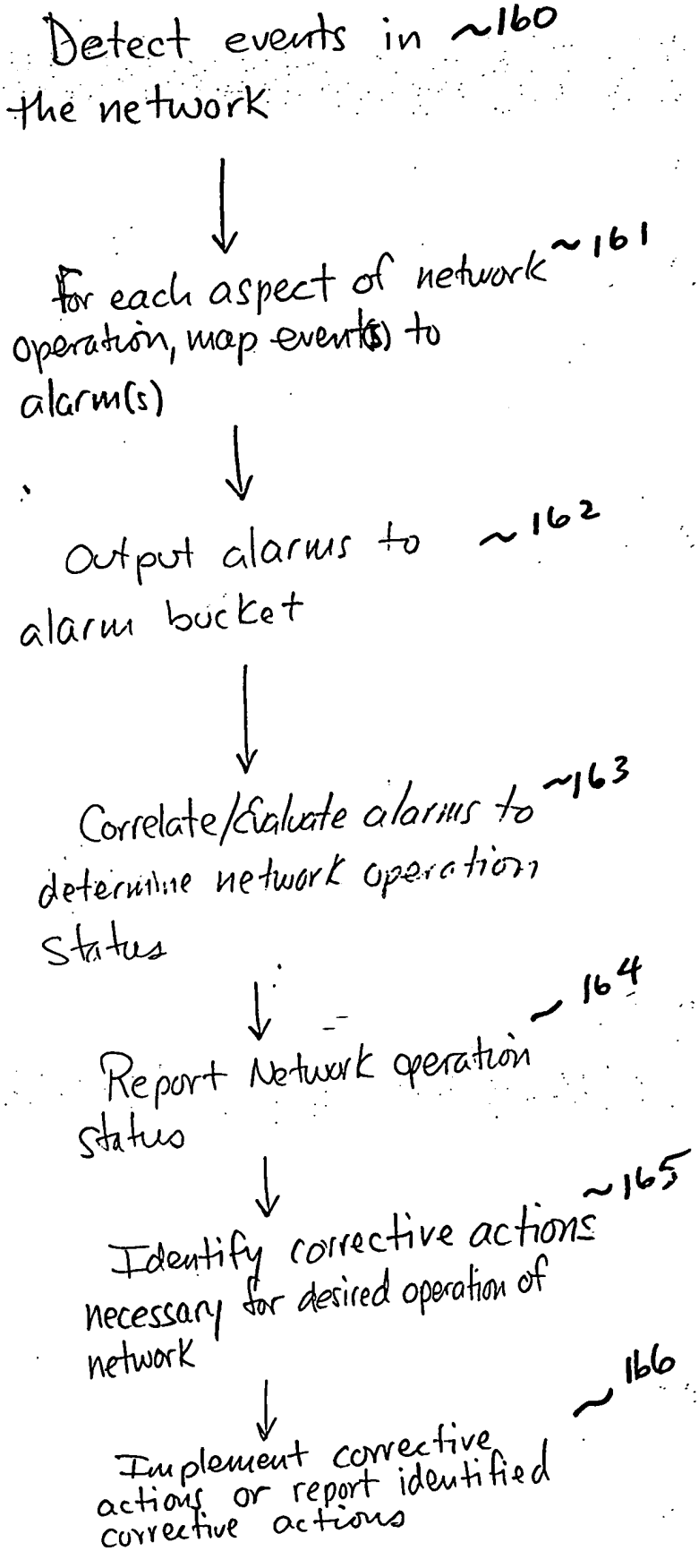
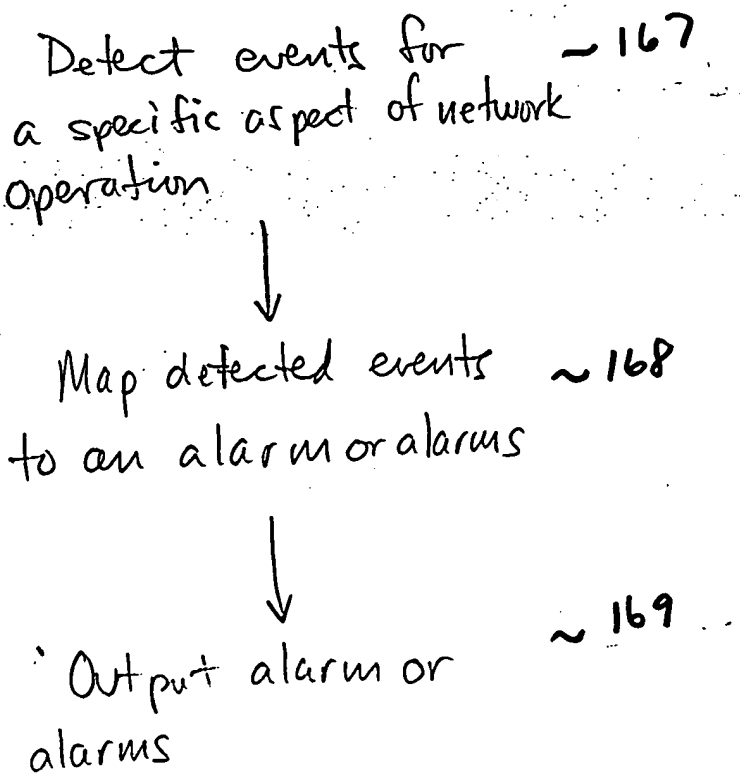

Detect events in the network
~160
for each aspect of network operation, map event(s) to alarm(s)
~161
Output alarms to alarm bucket
~162
Correlate/Evaluate alarms to determine network operation status
~163
Report Network operation status
~164
Identify corrective actions necessary for desired operation of network
~165
Implement corrective actions or report identified corrective actions
~166

Fig. 20


Detect events for a specific aspect of network operation
~167
Map detected events to an alarm or alarms
~168
Output alarm or alarms
~169

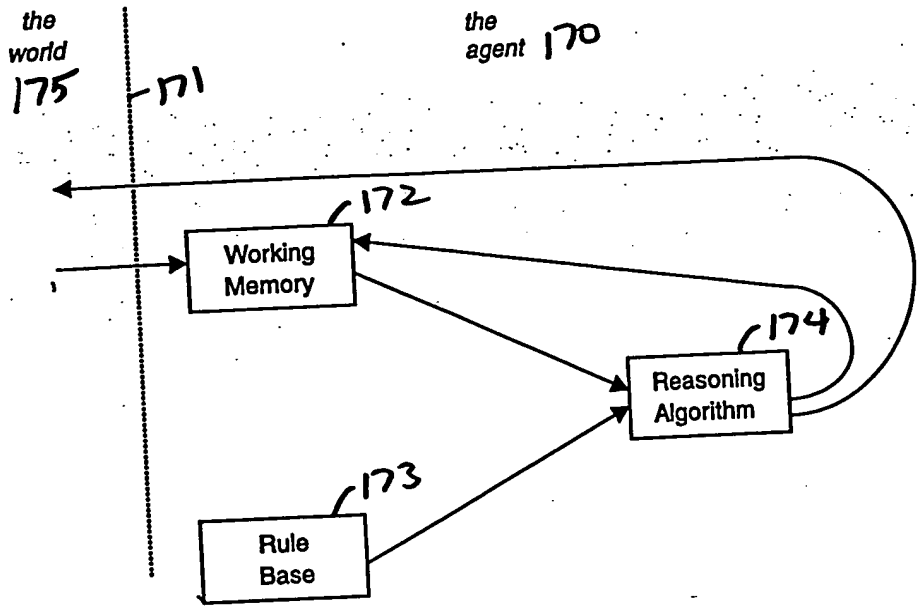

the world
175
171
the agent
170
172
Working Memory
174
Reasoning Algorithm
173
Rule Base

Fig. 21

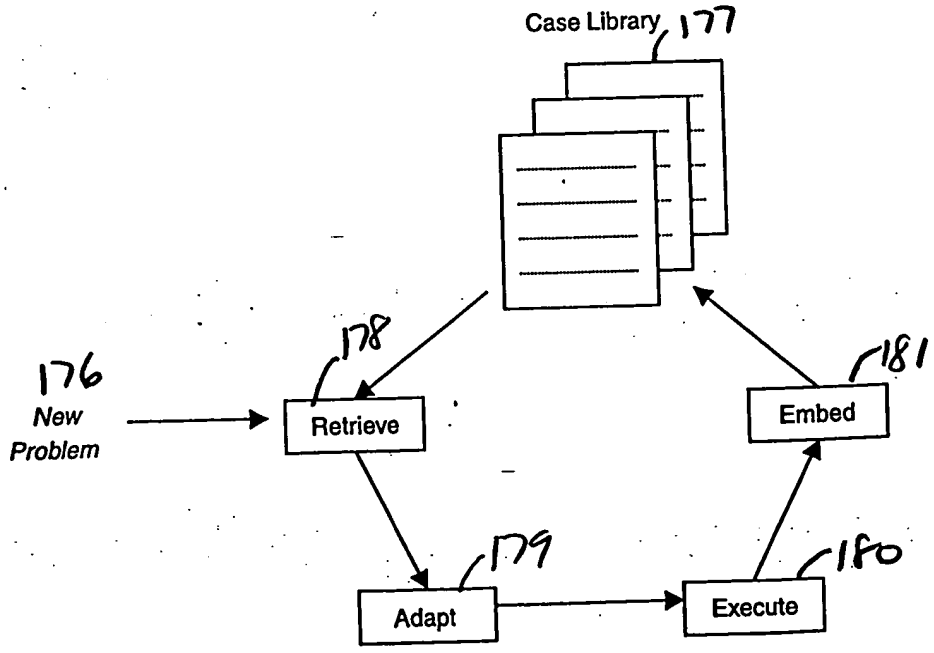

Case Library
177
176
New Problem
178
Retrieve
181
Embed
179
Adapt
180
Execute

Fig. 22

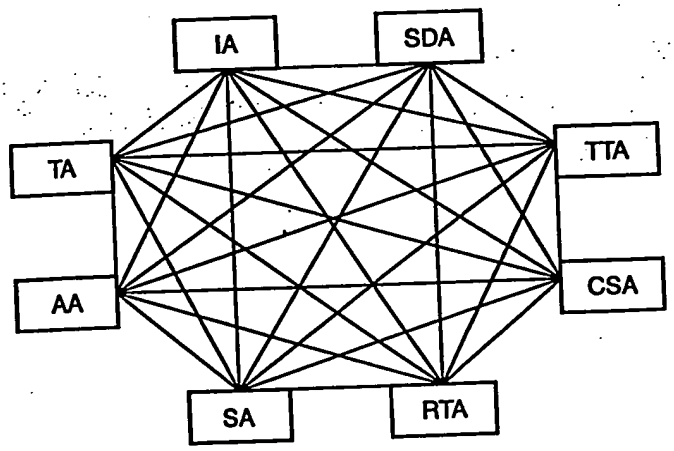


Fig. 23

190

Friday January 5 2001 —191			
	Service 1	Service 2	Service 3
Seattle			
Bldg 1	Up	Up	Down, up at 12 PM
Bldg 2	Down 8-10 PM	Down 8-10 PM	Down 8-10PM
Bldg 3	Up (Slow)	Up	Up
Sydney			
Bldg 1	Up	Up	Down, up ?
Bldg 2	Up	Up (slow)	Up
. . .			

Fig. 24

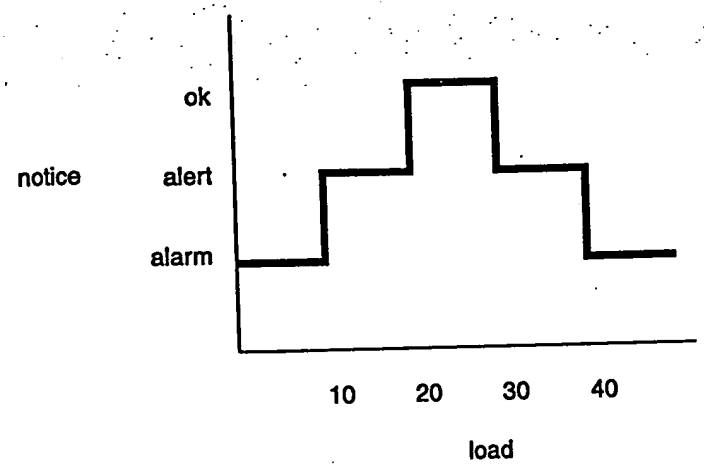

ok
notice
alert
alarm
10
20
30
40
load

Fig. 25

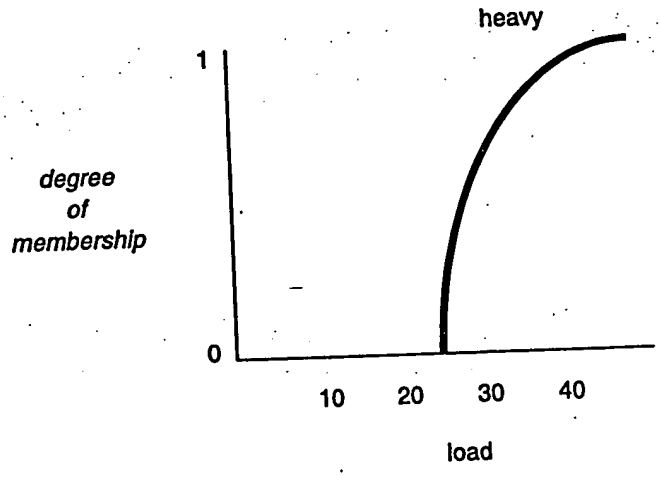

heavy
1
degree
of
membership
0
10
20
30
40
load

Fig. 26

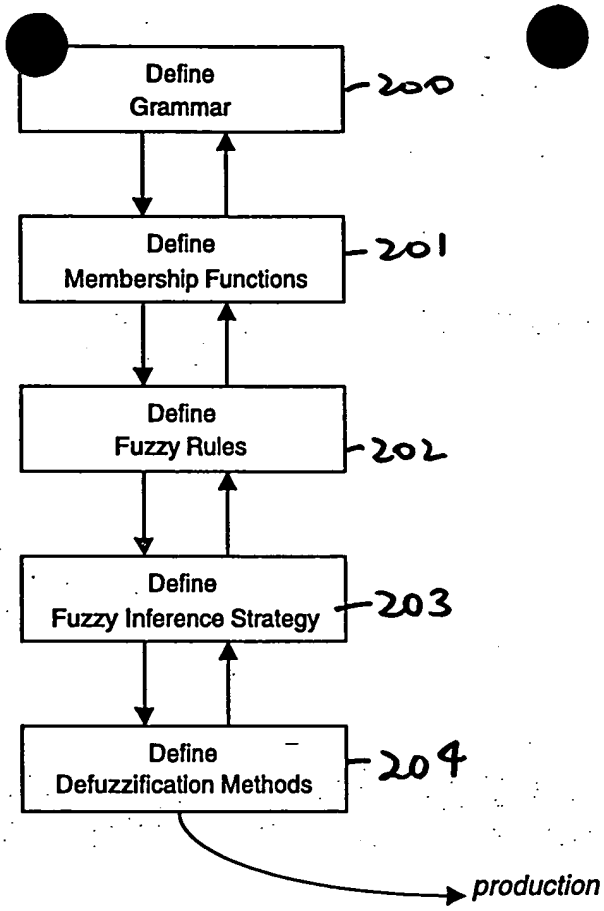

Define Grammar
200
Define Membership Functions
201
Define Fuzzy Rules
202
Define Fuzzy Inference Strategy
203
Define Defuzzification Methods
204
production

Fig. 27

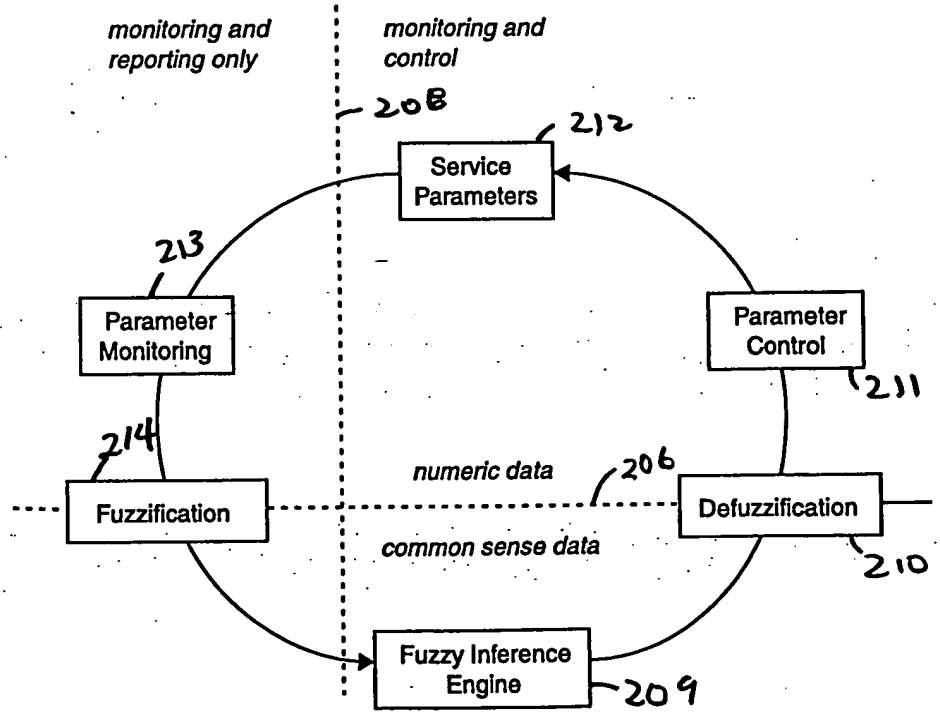
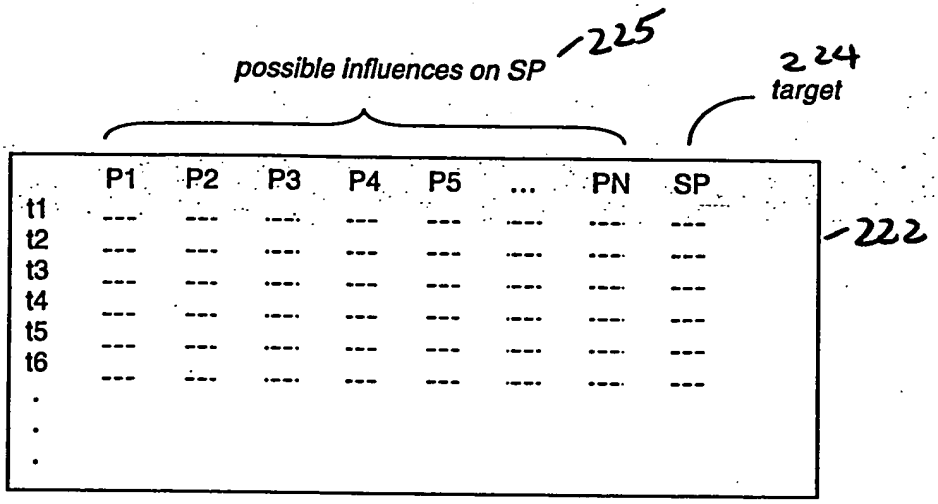

monitoring and reporting only
monitoring and control
208
212
Service Parameters
213
Parameter Monitoring
Parameter Control
211
214
numeric data
206
Fuzzification
Defuzzification
common sense data
210
Fuzzy Inference Engine
209

Fig. 28


possible influences on SP
225
224
target
P1 P2 P3 P4 P5 ... PN SP
t1
t2
t3
t4
t5
t6
222

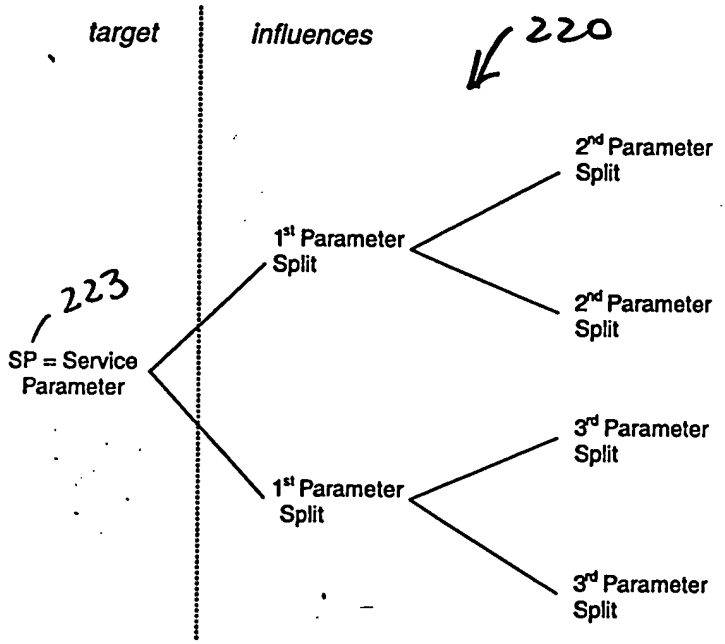

target
influences
220
223
SP = Service Parameter
1st Parameter Split
2nd Parameter Split
2nd Parameter Split
1st Parameter Split
3rd Parameter Split
3rd Parameter Split

Fig. 29

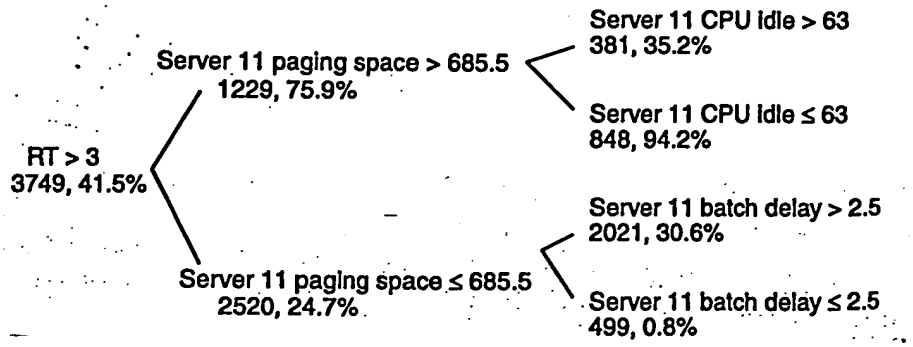

RT > 3
3749, 41.5%
Server 11 paging space > 685.5
1229, 75.9%
Server 11 paging space ≤ 685.5
2520, 24.7%
Server 11 CPU Idle > 63
381, 35.2%
Server 11 CPU Idle ≤ 63
848, 94.2%
Server 11 batch delay > 2.5
2021, 30.6%
Server 11 batch delay ≤ 2.5
499, 0.8%

Fig. 30

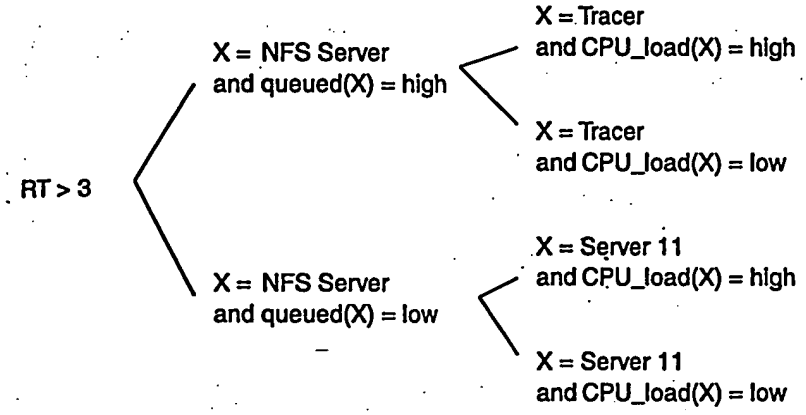

RT > 3
X = NFS Server
and queued(X) = high
X = NFS Server
and queued(X) = low
X = Tracer
and CPU_load(X) = high
X = Tracer
and CPU_load(X) = low
X = Server 11
and CPU_load(X) = high
X = Server 11
and CPU_load(X) = low

Fig. 31

230

Service Agreement with XYZ Server Farm

Name
Address
Phone
Email

Policies

Availability	___ (select 90 – 100 %)	$___
Response Time	___ (select 2 – 5 sec)	$___
Security	___ (select high- med-low)	$___
Integrity	___ (select high- med-low)	$___
	Total:	$___

Go Back *(Month)* *Go Forward*

Default: Availability ____ Response time ____ Security ____ Integrity____

Send Cancel

Fig. 32

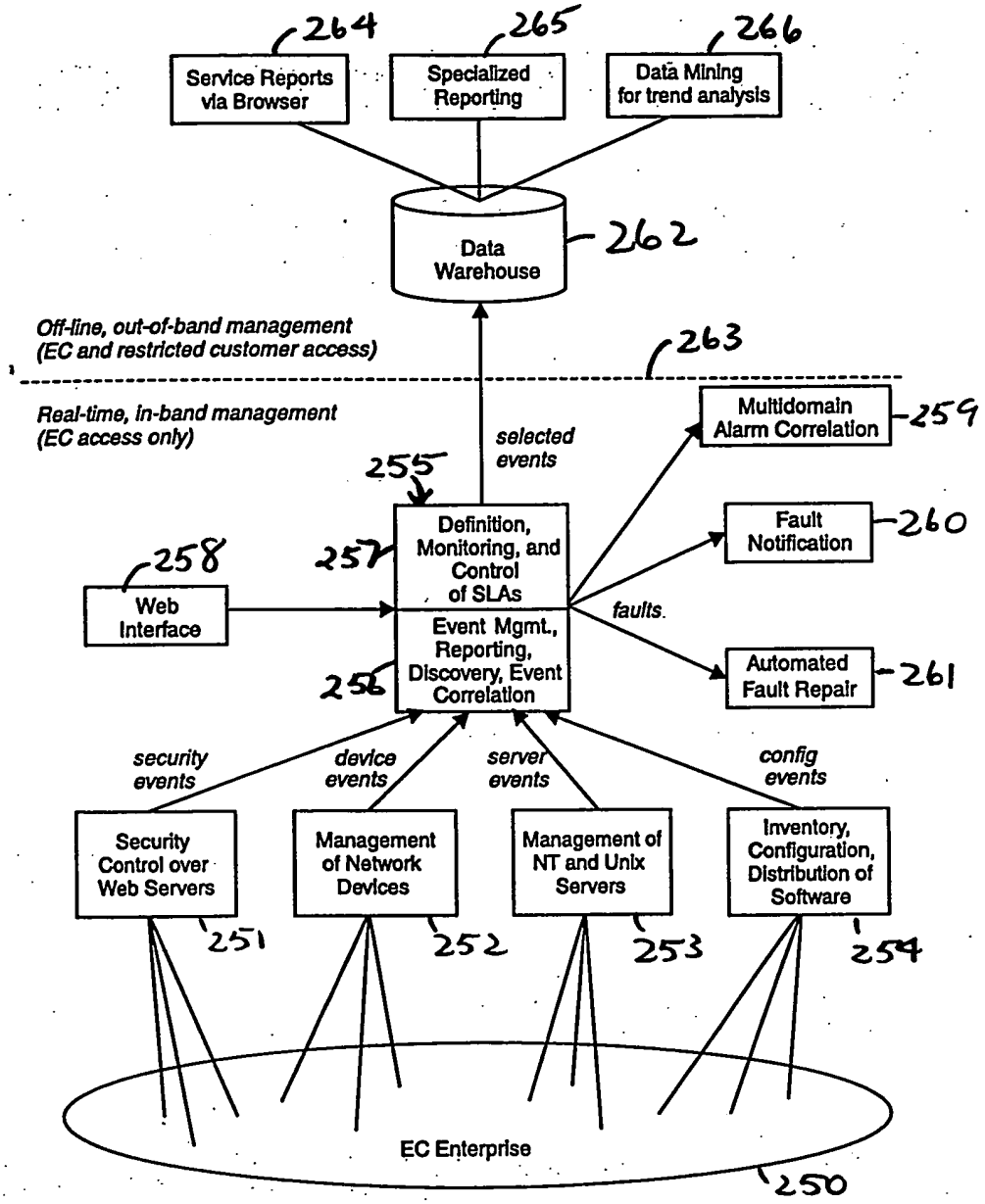

264
265
266
Service Reports via Browser
Specialized Reporting
Data Mining for trend analysis
Data Warehouse
262
Off-line, out-of-band management
(EC and restricted customer access)
263
Real-time, in-band management
(EC access only)
selected events
255
Multidomain Alarm Correlation
259
Fault Notification
260
257
Definition, Monitoring, and Control of SLAs
258
Web Interface
faults.
Event Mgmt., Reporting, Discovery, Event Correlation
256
Automated Fault Repair
261
security events
device events
server events
config events
Security Control over Web Servers
Management of Network Devices
Management of NT and Unix Servers
Inventory, Configuration, Distribution of Software
251
252
253
254
EC Enterprise
250

Fig. 33

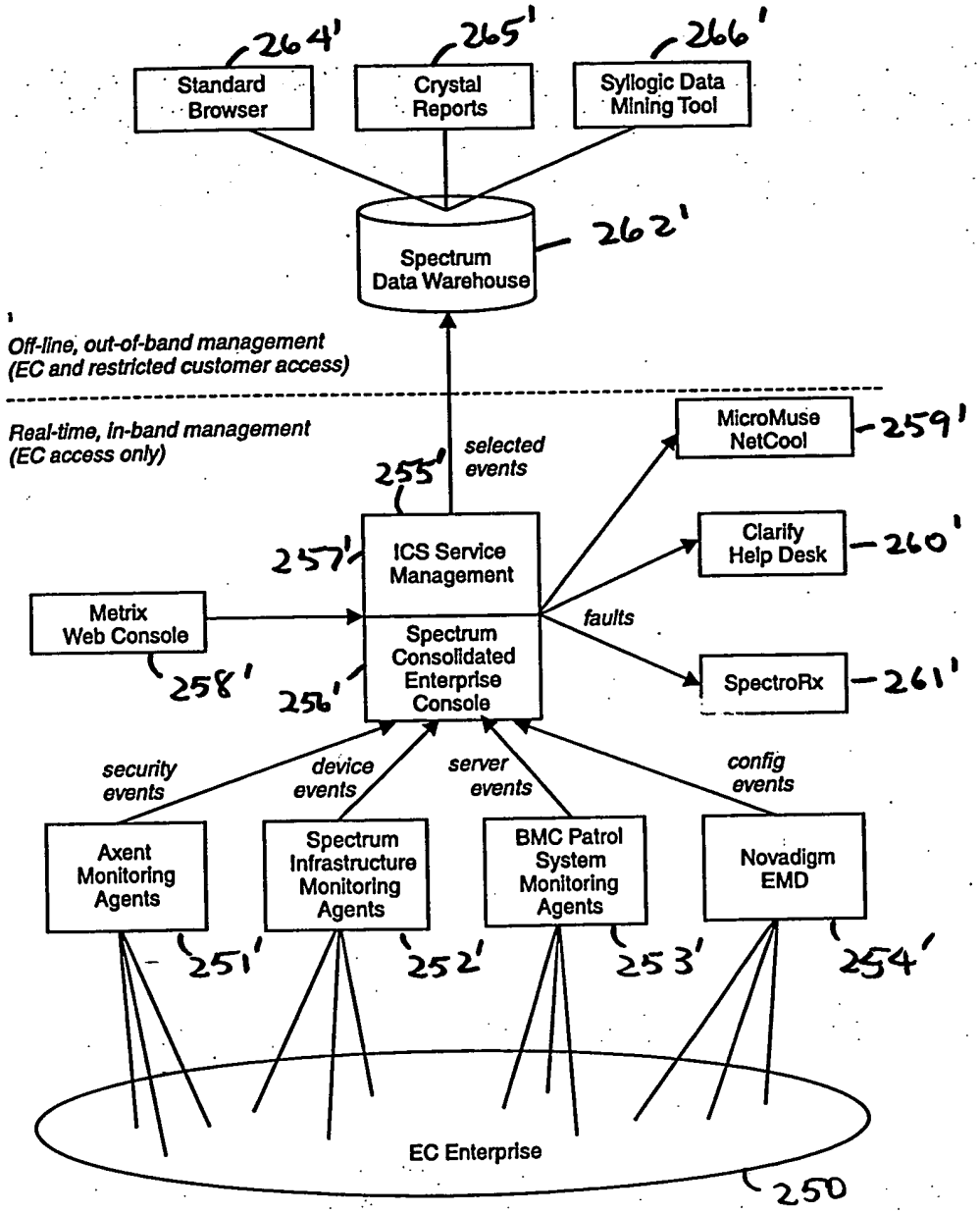

264'
265'
266'
Standard Browser
Crystal Reports
Syllogic Data Mining Tool
Spectrum Data Warehouse
262'
Off-line, out-of-band management
(EC and restricted customer access)
Real-time, in-band management
(EC access only)
selected events
255'
MicroMuse NetCool
259'
257'
ICS Service Management
Clarify Help Desk
260'
Metrix Web Console
faults
Spectrum Consolidated Enterprise Console
SpectroRx
261'
258'
256'
security events
device events
server events
config events
Axent Monitoring Agents
Spectrum Infrastructure Monitoring Agents
BMC Patrol System Monitoring Agents
Novadigm EMD
251'
252'
253'
254'
EC Enterprise
250

Fig. 34

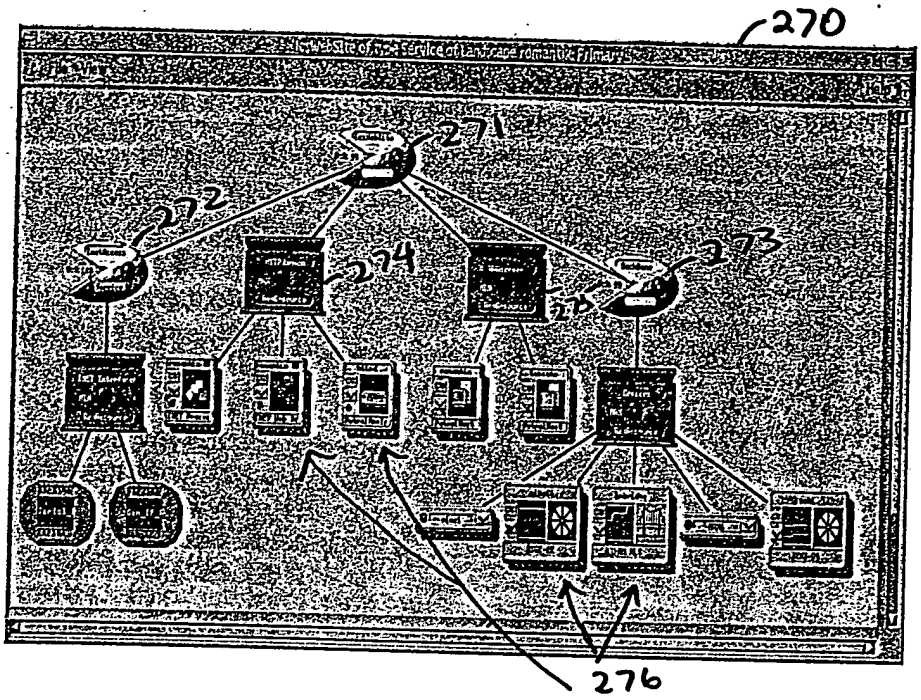

270
271
272
273
274
275
276

Fig. 35

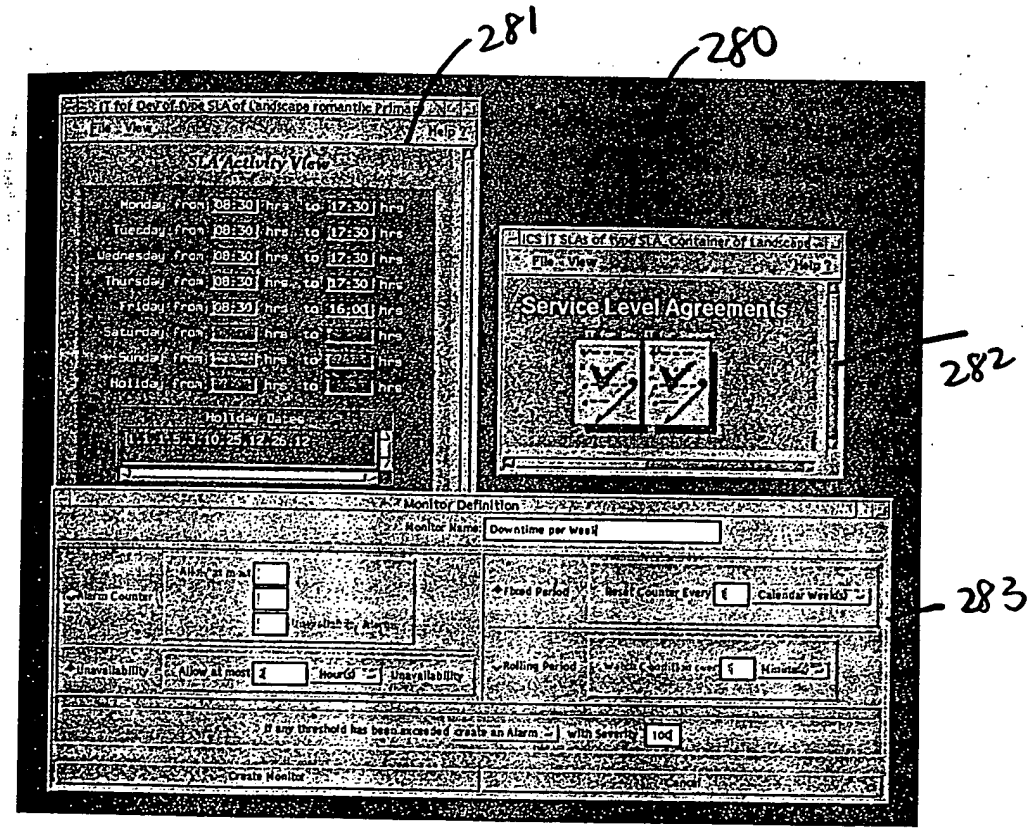

281
280
SLA Activity View
Service Level Agreements
282
Monitor Definition
Monitor Name:
Downtime per week
283

Fig. 36

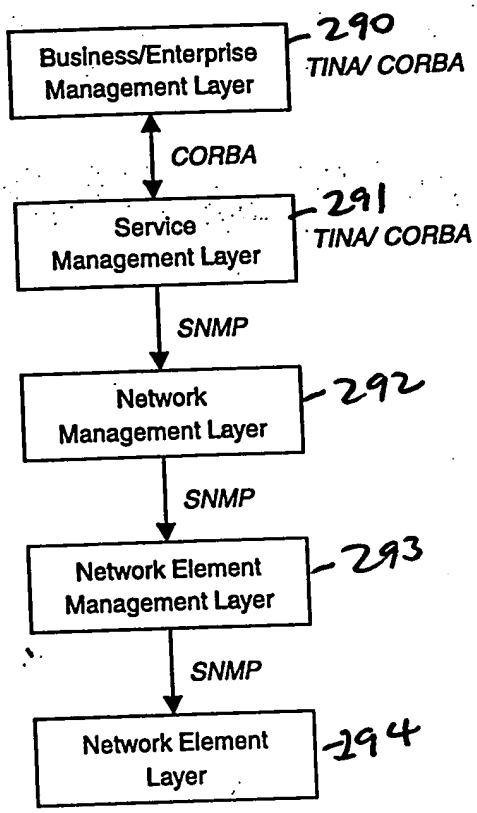

Business/Enterprise Management Layer
290
TINA/ CORBA
CORBA
Service Management Layer
291
TINA/ CORBA
SNMP
Network Management Layer
292
SNMP
Network Element Management Layer
293
SNMP
Network Element Layer
294

Fig. 37

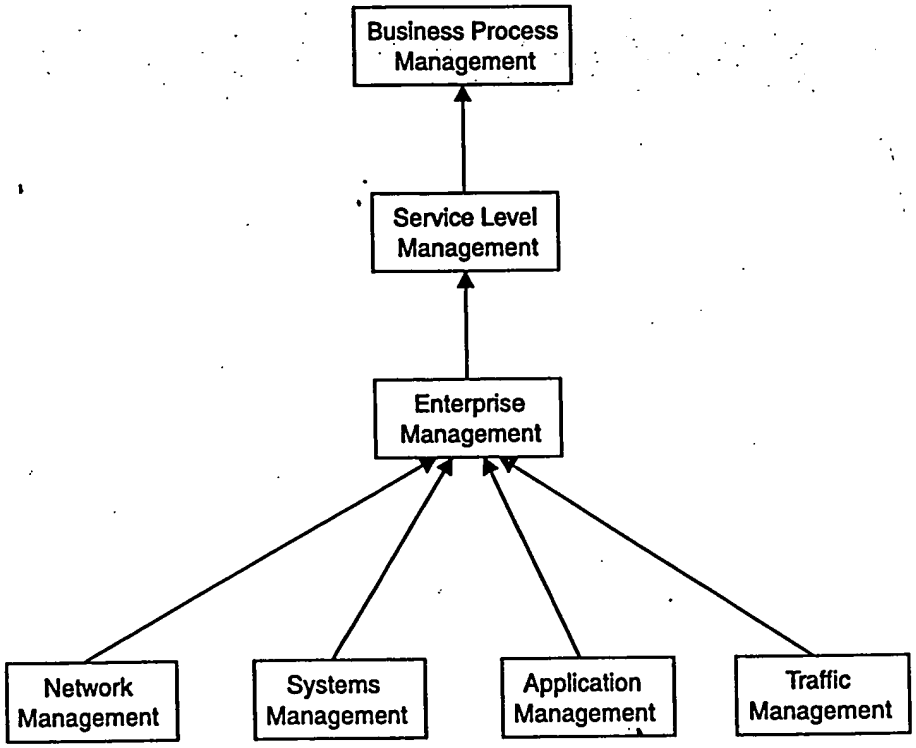

Business Process Management
Service Level Management
Enterprise Management
Network Management
Systems Management
Application Management
Traffic Management

Fig. 38